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NIOBIUM AND TANTALUM IN MODERN INDUSTRY

Niobium (columbium) and tantalum are two of the rare metals necessary to our industrial economy which are becoming increasingly important. Modern technology demands an ever-expanding production of rare metals for new applications in industry. Substitutes for these metals are many, but as rapidly as a cheaper or better substitute is developed, a new use is discovered for the replaced metal.

Polished niobium and tantalum are like platinum in appearance; they are somewhat darker and bluer when unpolished. Both of these metals are in Group 5 of the Periodic Table of Elements, and each exhibits a positive valence of two or five. Niobium has an atomic weight of 93.3, whereas tantalum has a higher atomic weight of 181.4. The ionic size, charge, and type of these elements is similar, causing them to occur commonly together. This similarity of properties makes separation of the metals from each other difficult.

Minerals containing niobium and tantalum usually occur in granite pegmatites, particularly where the primary feldspar is albite. The most important ores are columbite-tantalite and microlite. The latter is a complex oxide containing essentially calcium, sodium, niobium, and tantalum, with hydroxyl and fluorine. Columbite is the end member of an isomorphous mineral series containing chiefly niobium, tantalum, iron, and manganese oxides. If the niobium content of the mineral exceeds that of tantalum, it is called columbite, and conversely, the tantalum-rich member is called tantalite.

For separation of niobium from tantalum, an ore having a high niobium to tantalum ratio is desirable; a high tantalum to niobium ratio is preferred for the recovery of tantalum. For economical employment in industry, tantalite should contain not less than 30 percent and preferably 45 percent tantalum oxide (Ta_2O_5), and the total Ta_2O_5 content plus niobium oxide (Nb_2O_5) content should not be less than 60 percent. Columbite should contain a minimum of 45 percent Nb_2O_5, and the Ta_2O_5 content is preferably low; some contracts specify a 10:1 ratio. The percentages quoted are nominal; contracts are arranged by mutual agreement between buyer and seller.

Because the concentrated ore is extremely expensive, the chemical treatment must be carried through with great care to avoid undue loss of material. Briefly, the separation of niobium from tantalum is effected through differences in the solubilities of the potassium double fluorides; the chemical treatment is designed to resolve the niobium and tantalum in the ore into these salts in the most economical and efficient manner. Electrolysis of the fused fluorides yields the metals in powder or crystal form. Massive tantalum metal is obtained by powder-metallurgy methods.

The primary use of niobium at the present is in the manufacture of "stabilized" austenitic (chromium-nickel) stainless steels. It is likewise employed as a means of reducing